



MAT 161

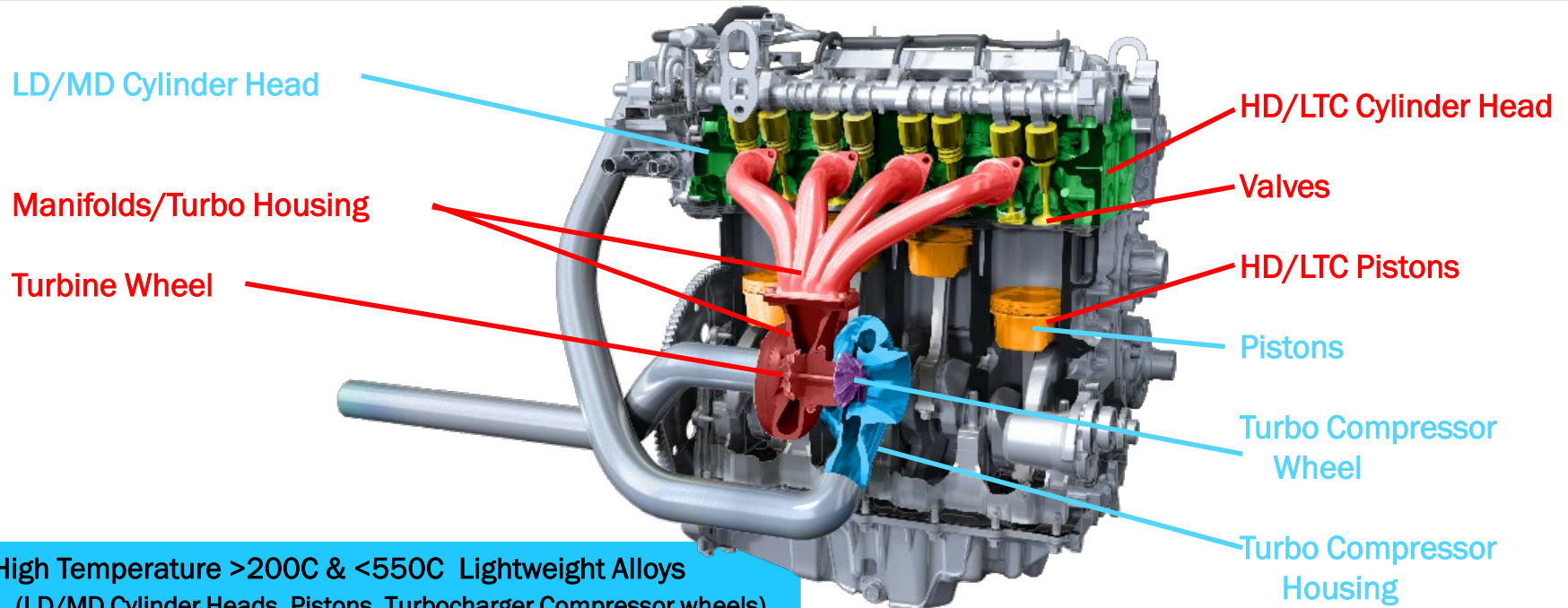
Powertrain Materials Core Program: Overview of Exploratory Projects

Jerry Gibbs, DOE

Thursday, June 13, 2019, 2:00 PM

Vehicle Technologies Office 2019 Annual Merit Review, Arlington, VA

Powertrain Materials Core Program



High Temperature $>200^{\circ}\text{C}$ & $<550^{\circ}\text{C}$ Lightweight Alloys
(LD/MD Cylinder Heads, Pistons, Turbocharger Compressor wheels)

Higher Temperature $>550^{\circ}\text{C}$ (Ni-, Fe-based) Alloys
(HD/CI/LTC Pistons, Valves, HD Cylinder Heads, Exhaust & Turbo Manifolds, Turbocharger Turbine Wheels)

Exploratory / Advanced Processing Techniques (includes Additive Manufacturing/Multi-material Hybrid Processes/ Structured MMC) (Pistons [reduced cooling], Heads [high PCP], Valve Seat Inserts, Rods, Thermal Management)

Advanced Materials Characterization, Synthesis, and Modeling using High Performance Computing (HPC), Needed for all other tasks

50/50 Cost Shared Industry CRADAs to advance early materials technologies to near application readiness

2019

2020

2021

2022

2023

2024

2025

Powertrain Materials Core Program

Timeline

- Lab call award – July 2018
- Kickoff: October 2018
- End: September 2023
- 5% Complete

Budget

- Powertrain Materials Core Program (PMCP): \$30M/5 years
- **Thrust 1:** \$1.15M (DOE funds)

FY19 PMCP Research Thrusts	FY19 Budget
1. Cost Effective LW High Temp Engine Alloys	\$1.15M
2. Cost Effective Higher Temp Engine Alloys	\$1.55M
3. Additive Manufacturing of Powertrain Alloys	\$1.05M
4. Advanced Characterization & Computation	\$1.55M
5. Exploratory Technologies	\$0.7M

Barriers

- **Materials performance and cost** constrain design of future advanced powertrains that achieve increased efficiency, lower emissions, improved performance and light weight (LW) structures; while also maintaining reliability and durability.
- **Materials development time.** Project leverages an Integrated computational materials engineering (ICME) framework to reduce the development & deployment of new LW alloys by up to 50% (< 5 years).

Partners

- Thrust 1 lead
 - Oak Ridge National Lab (ORNL)
- Thrust 1 & 4 partners
 - Pacific Northwest National Lab (PNNL)
 - Argonne National Lab (ANL)

Exploratory Projects

Small, one-year exploratory projects - competed annually between program labs

- Intended to rapidly demonstrate concept value.
 - Selected by DOE VTO staff
 - ~\$150k/yr projects
 - Each of the three participating labs can submit up to 4 white papers/year
 - Approximately 4 projects per year will be funded by VTO
- Projects that demonstrate exceptional potential may be:
 - awarded a second year
 - elevated to a larger, long-term project
- Schedule:
 - FY20: Year 2 white papers due Aug 2019
 - Opportunity for informal collaborations



PNNL

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Exploratory Projects

Competitive Process

Year 1

12 white papers

→ 6 selected for formal presentations

→ → 4 Tasks selected (November 2018)

Year 2

12 new white papers + 4 Year 1 white papers (Due Aug 2019)

→ 8 selected for formal presentations

→ → 4 Tasks selected (October 2019)

Year 1 Exploratory Projects

1. ORNL

Novel Materials for Polymer Composite Engine Blocks

PI: Vlastimil Kunc, Brian Knouff, Amit Naskar

2. ANL

Development of High Temperature Sample Environment for Advanced Alloy Characterization Utilizing High-Speed, Micron Resolution X-Ray Imaging Techniques

PI: Andrew Chuang

3. ORNL

Advanced Anticorrosion Coatings on Lightweight Magnesium Alloys by Atmospheric CO₂ Plasma Treatment

PI: Gyoung Gug Jang, Michael P. Brady

Year 1 Exploratory Projects

4. PNNL

High Strength Aluminum-Graphene Composite for Powertrain System

PI: Xia Li

5. ORNL

A Novel Synthesis Route to Produce Stronger and Lighter Metal Matrix Nanocomposites for Light Weight, Next Generation Powertrain Applications

PI: Zhili Feng and Jun Qu

Note: Tasks 4 & 5 are coordinated

This afternoon

**Exploratory Projects will present their
progress (first 6 months)**

Please join us at 4:00 PM in this room
to provide your feedback

Thank you!

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